

AMENDMENTS TO THE CLAIMS

Please cancel claims 53-105, 108-181, 184-193 and 196-245 without prejudice or disclaimer and please amend claims 106, 107, 194 and 247-251.

The following listing of claims will replace all previous claims and listings in the application

1. (Original) A hybrid inorganic/organic material comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with a surface of a second material.
2. (Original) The hybrid material of claim 1, wherein the second material is a containment vessel.
3. (Original) The hybrid material of claim 1, wherein the scaffolding functionality is selected from the group consisting of vinyl, acrylate, methacrylate, acrylamide, methacrylamide, styrene, divinylbenzene, itaconate, fumarate, alkyne, and combinations thereof.
4. (Original) The hybrid material of claim 1, wherein the surface of the second material is derivatized with an anchoring functionality.
5. (Original) The hybrid material of claim 4, wherein the anchoring functionality is selected from the group consisting of vinyl, acrylate, methacrylate, acrylamide, methacrylamide, styrene, divinylbenzene, itaconate, fumarate, alkyne, azo compounds, and combinations thereof.
6. (Original) The hybrid material of claim 4, wherein the scaffolding functionality and the anchoring functionality are copolymerizable.
7. (Original) The hybrid material of claim 2, wherein containment vessel is selected from the group consisting of a capillary column, a glass lined steel column, a radial compression column,

a trap column, a microfluidic device, a microchip, a sensor, an electronic circuit, a miniaturized SPE device, and an on-column frit.

8. (Original) The hybrid material of claim 2, where the containment vessel is a fused silica capillary column.

9. (Original) The hybrid material of claim 1, wherein the chemical interaction is formation of a covalent bond.

10. (Original) The hybrid material of claim 9, wherein the covalent bond is formed by polymerization.

11. (Original) The hybrid material of claim 10, wherein the polymerization is initiated with a radical initiator.

12. (Original) The hybrid material of claim 11, wherein the radical initiator is minimally water soluble.

13. (Original) The hybrid material of claim 11, wherein the initiator is selected from the group consisting of 2,2'-azobis(isobutyronitrile), 2,2'-azobis(2-methylpropionamidine) dihydrochloride, 4,4'-azobis(4-cyanovaleic acid), potassium persulfate, and peracetic acid.

14. (Original) The hybrid material of claim 1, wherein the inorganic portion of the hybrid material is a material selected from the group consisting of alumina, silica, titanium oxide, zirconium oxide, and ceramic material.

15. (Original) The hybrid material of claim 1, wherein the inorganic portion of the hybrid material is silica.

16. (Original) The hybrid material of claim 1, wherein the PSN is the product of a reaction of an organosilane and an inorganic silane monomer.

17. (Original) The hybrid material of claim 16, wherein the PSN is the product of a reaction of a tetraalkoxysilane and an organosilane containing at least one polymerizable group.

18. (Original) The hybrid material of claim 17, wherein said tetraalkoxysilane has the formula $\text{Si}(\text{OR}^1)_4$, where R^1 is a $\text{C}_1 - \text{C}_3$ alkyl moiety.

19. (Original) The hybrid material of claim 17, wherein said organosilane is an organoalkoxysilane having the formula $\text{R}^2\text{Si}(\text{OR}^1)_3$ or $\text{R}^6[\text{Si}(\text{OR}^1)_3]_m$ where R^2 is a styryl, vinyl, an acrylate, methacrylate, acrylamide, methacrylamide, divinylbenzene, itaconate, fumarate, substituted or unsubstituted $\text{C}_1 - \text{C}_{18}$ alkenylene, alkynylene or arylene, or a combination thereof; R^1 is a $\text{C}_1 - \text{C}_4$ alkyl moiety; R^6 is a substituted or unsubstituted $\text{C}_1 - \text{C}_{18}$ alkenylene, alkynylene or arylene moiety bridging two or more silicon atoms; and m is an integer greater than or equal to two.

20. (Original) The hybrid material of claim 19 wherein R^2 is vinyl, methacryloxypropyl, methacrylamidepropyl, or styrylethyl and R^1 is methyl or ethyl; or R^6 is a bridging N,N -bis(propylene) acrylamide group, $m = 2$, and R^1 is ethyl or methyl.

21. (Original) The hybrid material of claim 17, wherein the organosilane is minimally water soluble.

22. (Original) The hybrid material of claim 17 wherein said tetraalkoxysilane is selected from the group consisting of tetramethoxysilane and tetraethoxysilane.

23. (Original) The hybrid material of claim 17, wherein the tetraalkoxysilane is tetramethoxysilane.

24. (Original) The hybrid material of claim 17, wherein the polymerizable group is 3-methacryloxypropyl.
25. (Original) The hybrid material of claim 17, wherein the polymerizable group is styrylethyl.
26. (Original) The hybrid material of claim 17, wherein the tetraalkoxysilane is minimally water soluble.
27. (Original) The hybrid material of claim 17, wherein the organosilane is (3-methacryloxypropyl)trimethoxysilane.
28. (Original) The hybrid material of claim 1, wherein said pore structure of said hybrid material is modified by further including a surfactant or combination of different surfactants in said reaction, and by subjecting said material to hydrothermal treatment.
29. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are nonionic surfactants.
30. (Original) The hybrid material of claim 29, wherein the surfactants are selected from the group consisting of surfactants comprised of block copolymers of polyethylene glycol and polypropyleneglycol, surfactants comprised of alkylphenoxyethoxyethanol, and polyethyleneglycol.
31. (Original) The hybrid material of claim 29, wherein the surfactant is Pluronic F38,
32. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are selected from surfactants with a hydrophile-lipophile balance ranging from about 0 to 60.

33. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are selected from surfactants with a hydrophile-lipophile balance ranging from about 10 to 50.

34. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are selected from surfactants with a hydrophile-lipophile balance ranging from about 20 to 40.

35. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are selected from surfactants with a hydrophile-lipophile balance ranging from about 30 to 40.

36. (Original) The hybrid material of claim 28, wherein said surfactant or combination of surfactants are selected from surfactants with a hydrophile-lipophile balance is about 33.

37. (Original) The hybrid material of claim 1, wherein said material has been surface modified by a surface modifier selected from the group consisting of an organic group surface modifier, a silanol group surface modifier, a polymeric coating surface modifier, and combinations thereof.

38. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a polymeric coating surface modifier.

39. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a combination of an organic group surface modifier and a silanol group surface modifier.

40. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a combination of an organic group surface modifier and a polymeric coating surface modifier.

41. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a combination of a silanol group surface modifier and a polymeric coating surface modifier.

42. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a combination of an organic group surface modifier, a silanol group surface modifier, and a polymeric coating surface modifier.

43. (Original) The hybrid material of claim 37, wherein said material has been surface modified by a silanol group surface modifier.

44. (Original) The hybrid material of claim 37, wherein said material has been surface modified via formation of an organic covalent bond between an organic group of the material and a surface modifier.

45. (Original) The hybrid material of claim 37, wherein the surface modifier has the formula $Z_a(R')_bSi-R$, where $Z = Cl, Br, I, C_1 - C_5$ alkoxy, dialkylamino or trifluoromethanesulfonate; a and b are each an integer from 0 to 3 provided that $a + b = 3$; R' is a $C_1 - C_6$ straight, cyclic or branched alkyl group, and R is a functionalizing group.

46. (Original) The hybrid material of claim 45 wherein R' is selected from the group consisting of methyl, ethyl, propyl, isopropyl, butyl, t-butyl, sec-butyl, pentyl, isopentyl, hexyl and cyclohexyl.

47. (Original) The hybrid material of claim 45 wherein said functionalizing group R is a $C_1 - C_{30}$ alkyl group.

48. (Original) The hybrid material of claim 45 wherein said functionalizing group R is a $C_1 - C_{20}$ alkyl group.

49. (Original) The hybrid material of claim 45 wherein said surface modifier is selected from the group consisting of octyltrichlorosilane, octadecyltrichlorosilane, octadecyldimethyl-N, N-dimethylaminosilane, octyldimethylchlorosilane, and octadecyldimethylchlorosilane.

50. (Original) The hybrid material of claim 45, wherein said surface modifier is octadecyldimethyl-N, N-dimethylaminosilane.

51. (Original) The hybrid material of claim 45, wherein said functionalizing group R is selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cyano, amino, diol, nitro, ester, a cation or anion exchange group, an alkyl group containing an embedded polar functionality and an aryl group containing an embedded polar functionality.

52. (Original) A hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with a surface of a second material.

Claim 53 - 105. (Cancelled)

106. (Currently Amended) A method of preparation of [a]the hybrid inorganic/organic monolith ~~comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with a surface of a second material of claim 52~~, said method comprising the steps of

- a) forming a sol-gel by the reaction of two or more monomers;
- b) initiating a polymerization reaction; and
- c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction, thereby preparing the hybrid inorganic/organic monolith.

107. (Currently Amended) [A]The method of claim 106 preparation of a hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with a surface of a second material, said method further comprising the steps of

— a) forming a sol-gel by the reaction of two or more monomers;
— b) initiating a polymerization reaction;
— c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction; and
— d) modifying the pore structure of the material;
thereby preparing the hybrid inorganic/organic monolith.

Claims 108 - 181 (Cancelled)

182. (Original) A separations device comprising

a) a surface capable of accepting a monolith material comprising a polymerized scaffolding nanocomposite (PSN) material, said surface comprising an anchoring functionality and
b) a hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with the anchoring functionality on said surface, and wherein said hybrid organic/inorganic monolith is anchored to said surface by a chemical interaction between said scaffolding functionality and anchoring functionality.

183. (Original) The separations device of claim 182, wherein said device is selected from the group consisting of chromatographic columns, thin layer plates, filtration membranes, sample cleanup devices, and microtiter plates.

Claims 184 – 193 (Cancelled)

194. (Currently Amended) [A] The separations device of claim 183, wherein the device is a fused-silica capillary column, comprising

— a) a fused-silica capillary column having a cylindrical interior surface capable of accepting a monolith comprising a polymerized scaffolding nanocomposite (PSN) material, said interior surface comprising an anchoring functionality, and

~~b) a hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with the anchoring functionality on said surface, and wherein said hybrid organic/inorganic monolith is anchored to said surface by a chemical interaction between said scaffolding functionality and anchoring functionality.~~

195. (Original) The fused-silica capillary column of claim 194, wherein the capillary column has

an inner diameter (I.D.) greater than 50 μm .

Claims 196 - 245 (Cancelled)

246. (Original) A method of *in situ* preparation of a hybrid inorganic/organic monolith in a fused-silica capillary column, said method comprising:

forming an anchoring functionality on an interior surface of said capillary column; and

forming inside said capillary column a hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with the anchoring functionality on said surface, said monolith being formed by:

a) forming a sol-gel by the reaction of two or more monomers;
b) initiating a polymerization reaction; and
c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction;
whereby said scaffolding functionality and said anchoring functionality chemically interact to thereby anchor said monolith to said surface, such that a hybrid inorganic/organic monolith is prepared *in situ* in the fused-silica capillary column.

247. (Currently Amended) [A]The method of *in situ* preparation of a hybrid inorganic/organic monolith in a fused-silica capillary column, said method claim 246 further comprising:

_____ forming an anchoring functionality on an interior surface of said capillary column; and

_____ forming inside said capillary column a hybrid inorganic/organic monolith comprising a polymerized scaffolding nanocomposite (PSN), wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with the anchoring functionality on said surface, said monolith being formed by:

- _____ a) forming a sol-gel by the reaction of two or more monomers;
- _____ b) initiating a polymerization reaction;
- _____ c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction; and
- _____ d) modifying the pore structure of the monolith;

whereby said scaffolding functionality and said anchoring functionality chemically interact to thereby anchor said monolith to said surface, such that a hybrid inorganic/organic monolith is prepared *in situ* in the fused silica capillary column.

248. (Currently Amended) [An]The inorganic/organic hybrid monolith of claim 52 comprising a scaffolding functionality capable of chemically interacting with a surface of a second material, produced by [the] a process comprising the steps of

- a) forming a sol-gel by the reaction of two or more monomers;
- b) initiating a polymerization reaction; and
- c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction.

249. (Currently Amended) [An]The inorganic/organic hybrid monolith comprising a scaffolding functionality capable of chemically interacting with a surface of a second material, produced by of claim 248, wherein the process of further comprises

- _____ a) forming a sol-gel by the reaction of two or more monomers;
- _____ b) initiating a polymerization reaction;
- _____ c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction; and
- _____ d) modifying the pore structure of the monolith.

250. (Currently Amended) A method of preparation of a hybrid inorganic/organic material comprising a polymerized scaffolding nanocomposite (PSN) of claim 1, comprising the steps of

- a) forming a sol-gel by the reaction of two or more monomers;
- b) initiating a polymerization reaction; and
- c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction,

thereby preparing the hybrid inorganic/organic material, ~~wherein the material contains a scaffolding functionality capable of chemically interacting with a surface of a second material.~~

251. (Currently Amended) [A]The method of preparation of a hybrid inorganic/organic material comprising a polymerized scaffolding nanocomposite (PSN) claim 250, further comprising the steps of

- ~~a) forming a sol-gel by the reaction of two or more monomers;~~
- ~~b) initiating a polymerization reaction;~~
- ~~c) allowing the monomers to react through a polymerization sol-gel (PSG) reaction; and~~
- ~~d) modifying the pore structure of the material;~~

thereby preparing the hybrid inorganic/organic material, ~~wherein the nanocomposite contains a scaffolding functionality capable of chemically interacting with a surface of a second material.~~